Individual's Affective Responses to High Intensity Interval Training Relative to Moderate Intensity Continuous Training

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Abstract

Even though physical activity among adults is associated with several health benefits, the majority of adults do not meet physical activity recommendations. Examining if the type of physical activity has an impact on an individual's affective and psychological responses is vital in potentially increasing the physical activity rates among young adults. The purpose of this study was to examine the affective responses among participants who completed a high intensity interval training (HIIT) class or a moderate intensity continuous training (MICT) class. Participants (n=41) were randomized to participate in either the HIIT or MICT class. There was no effect of group assignment on enjoyment, self-efficacy for physical activity, tranquility, positive engagement, or revitalization. There was an effect of group assignment on physical exhaustion and mid-class affect. HIIT resulted in more physical exhaustion and displeasurable affect during physical activity than MICT. However, group assignment did not impact participant's enjoyment or post-class affect. These findings suggest that although HIIT requires more exertion and intensity relative to MICT, the affect and enjoyment experienced as a result of physical activity does not differ. Given the lack of physical activity in young adults, examining enjoyable avenues for physical activity is crucial. Further research is needed to examine the extent that affect before, during, and after a session of physical activity predicts future engagement in physical activity.

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Review of Literature

Moderate-to-vigorous physical activity significantly reduces an individual's blood pressure, improves insulin sensitivity, improves sleep patterns, reduces symptoms of anxiety, and improves aspects of cognition (USDHHS, 2018). Individuals who meet recommended levels of physical activity behavior typically experience positive health outcomes in the aforementioned areas, in addition to other benefits, such as quality of life and physical function (USDHHS, 2018). The United States Department of Health and Human Services recommends that adults engage in 150 minutes per week of moderate-intensity or 75 minutes per week of vigorous-intensity physical activity. Based on self-report measures only 19% of women and 26% of men meet the physical activity guidelines (USDHHS, 2018). As few as 5% of adults meet the guidelines when physical activity is assessed objectively via an accelerometer (Tucker et al., 2016). Additionally, as individuals transition into adulthood, physical activity levels commonly decrease (Lox et al., 2016). Given all of this, time-efficient interventions are needed to effectively increase physical activity among sedentary adults. This suggests that individuals transitioning into adulthood may be an important population to target regarding physical activity interventions.

HIIT

High intensity interval training (HIIT) is a form physical activity that consists of small bouts of intense physical activity interspersed with rest intervals. HIIT has been shown to produce physiological benefits similar to endurance training despite the reduced time commitment of HIIT relative to endurance training in adults. Specifically, previous studies have found that individuals can obtain physiological benefits from HIIT even when the amount of time spent training was 75% to 90% lower than traditional methods (Little et al., 2010). HIIT has

continued to grow in popularity throughout the last decade as it has become more accessible and widespread (Walter, 2019). One reason for the continued accessibility and growth of HIIT is technological advances (Ing et al., 2018; Blackwell et al., 2017). These studies represent a trend indicating programs transmitted digitally, and remotely, can be as impactful as in-person HIIT programs. HIIT workouts can be accessible and affordable for those who feel they do not have the time or resources to pursue in-person or group-based physical activity sessions.

HIIT Health Impact

HIIT has been shown to have positive health benefits relative to moderate intensity interval training (MICT) and other forms of physical activity even though HIIT requires less of a time commitment (Little et al., 2010; Nybo et al., 2010; Ramos et al., 2015). Ramos et al. (2015) conducted a meta-analysis comparing the health-related impact of HIIT compared to MICT in adults. They concluded that HIIT was superior for cardiorespiratory fitness, cardiovascular disease risk factors, and vascular function in comparison to MICT. For example, Nybo et al. (2010) evaluated the effect of a HIIT running program on health-related variables relative to MICT and strength training programs after 12 weeks in their randomly assigned program. The HIIT group experienced a significant improvement in their systolic blood pressure following the program relative to MICT and the strength training group, and all three groups experienced significant improvement in mean arterial pressure. Additionally, the HIIT group experienced the greatest improvement in cardiovascular fitness relative to the other two groups. However, the MICT group experienced superior results in metabolic fitness relative to the HIIT and strength training group. Also, the strength training group exhibited the most significant improvements in muscle and bone mass relative to the HIIT and MICT groups (Nybo et al., 2010). Although not

the best form of physical activity for every health measure, HIIT was observed to be as good or better than MICT and strength training on several important health measures.

Little et al. (2010) observed how a low-volume HIIT program impacted adults' physical activity performance and muscle metabolic adaptations. The program consisted of six physical activity sessions per week totaling 85 minutes spent engaging in physical activity each week. This study demonstrated that after two weeks, the time efficient HIIT program is a practical strategy for increased mitochondrial biogenesis, which allows for skeletal muscles to increase mass, and improve functional physical activity capacity at the end of the program relative to the beginning. The positive health-outcomes in this study are similar to previous studies tracking these health-related outcomes in more time-consuming traditional endurance physical activity programs (Little et al., 2010). There is a need to better understand the effect of HIIT on variables that may impact adherence, such as affect and enjoyment.

Affective Response, Emotion, and Mood

Research has linked physical activity adherence to three states including mood, emotion, and affective responses (Crocker et al., 2004; Ekkekakis, 2010; Williams et al., 2008). These terms are commonly used interchangeably and often lack clarity regarding their definition (Ekkekakis, 2003). Therefore, each term will be defined below before reviewing the physical activity literature related to affective response, emotion, and mood.

Mood

Mood is the most stable of the three states. In mood, there is an absence of specific cognitive appraisal and physiological patterns that are typically present when discussing emotion and affective response. For example, if someone was engaging in physical activity and was in a displeasurable mood, their mood might not be attributed to the bout of physical activity since

mood is often not influenced by a single event or modified easily (Crocker et al., 2004). Although mood is not derived from a specific stimulus, it does influence the responses to various stimulus to be consistent with their mood state. This may lead to a lowering of the threshold required to have a response congruent with one's mood (Ekkekakis & Petruzzello, 2000). For example, if someone's mood is gloomy, less of a displeasurable stimulus is required to create a distressed emotional response. More broadly, moods are viewed not as a response to a specific event, but as a response to how an individual sees the world and their place in it. Moods are believed to be less intense and generally longer lasting, which is an important difference between mood and emotion (Ekkekakis & Petruzzello, 2000).

Emotion

Emotions are based upon immediate cognitive appraisals. Meaning, an individual will encounter a stimulus, processes the stimulus, and then an emotion will develop. Since they are a response to a specific stimulus, emotions require cognition in order for an individual to experience an emotion. It is also important to note that emotions are meaningful to individuals given the cognitive process (Ekkekakis & Petruzzello, 2000). An example of emotion would be one experiencing a change in their exercise feeling, enjoyment, or arousal due to a session of exercise, as these are experienced as a response to a specific stimulus. Emotions are typically measured in physical activity using the Physical Activity Enjoyment Scale (PACES) and Exercise-Induced Feeling Inventory (EFI). They are also typically depicted as being relatively short in duration but high in intensity (Ekkekakis & Petruzzello, 2000). In comparison to affective response, emotion is thought of as a more complex process potentially created by affective response components (Ekkekakis, 2003).

Affective Response

Affect is considered a state that is irreducible, which explains why it is often referred to as a "core" or "basic" response (Ekkekakis, 2003). It is the simplest and most primitive of the three states (Ekkekakis, 2003). Affect is present in all emotion, but emotion is not present in all affect (Ekkekakis & Petruzzello, 2000). An affective response is hedonic in nature as it results in a subjective feeling of either pleasure or displeasure (Crocker et al., 2004). A basic affective response can be experienced through a set mechanism, which allows for very little flexibility, such as the displeasure associated with pain during an intense bout of physical activity (Ekkekakis & Petruzzello, 2000). Affective response is commonly measured using the Feeling Scale (FS). There are several theories used to explain how mood, emotion, and affective response impact one's experience in physical activity. To follow is a discussion of the theories most relevant to HIIT.

Theoretical Mechanisms for Physical Activity Adherence

Hedonic Theory

Hedonic theory suggests that the feelings one experiences during physical activity, or their affective response, may dictate their future desire to engage in physical activity (Jung et al., 2014). Hedonic theory can be especially important for individuals who are new to physical activity, as they may base their decision regarding future physical activity on their initial affective response to physical activity (Williams et al., 2008). Hedonic theory suggests that higher intensity physical activity results in displeasurable affective responses in adults; however, as will be discussed later, this may not be the case when high intensity activity occurs in intervals (Williams et al., 2008).

Williams et al. (2008) examined how sedentary adults' affective responses to a session of physical activity impacted their future levels of physical activity. Participants were encouraged

to engage in 30 minutes of moderate intensity physical activity per day. Participants completed FS and Borg's Rating of Perceived Exertion (RPE) measures before, during, and after their session of physical activity. Results indicated that participants who reported a more pleasurable initial affective response (as measured by the Feeling Scale) to physical activity reported more minutes of physical activity, both six and 12 months later. Specifically, a shift of one unit on the Feeling Scale (FS) resulted in a 38-minute increase of physical activity at six months and a 41-minute increase at 12 months (Williams et al., 2008). This finding is significant as there is a clear relationship between long-term physical activity adherence and initial affective responses to physical activity.

Another study found that affective responses to a single session of physical activity can have a more immediate impact on the next session of physical activity an individual engages in, albeit on a smaller scale. Williams et al. (2016) examined how individual's physical activity adherence was impacted when randomizing participants into a self-paced and moderate intensity physical activity group. To measure the participant's responses, FS questionnaires were used. The study observed an increase in future physical activity behavior when participants reported a more pleasurable affective response to a single session of physical activity. On average, a 13-minute increase of time spent engaging in physical activity was observed in the next session of physical activity when there was a positive, one-unit shift on the feeling scale in the previous session. This increase was multiplied by the number of days that occurred between the most recent physical activity session and the following one. Meaning, if a participant exhibited a positive one-unit shift on the FS, and had three days between physical activity sessions, their next physical activity session would be expected to be 39 minutes long (Williams et al., 2016). This finding suggests individual's affective responses to physical activity not only impact their

long-term engagement in physical activity, but also their behavior in the next session of physical activity.

Dual-Mode Theory

Dual-mode theory suggests that an individual can experience a pleasurable affective response even after completing physical activity perceived as an aversive stress or stimulus (Hoekstra et al., 2017). This rebound signifies a significant increase in affective response immediately following the experience of an aversive stress or stimulus. This pleasurable experience after completing physical activity can lead individuals to maintain their physical activity behavior (Oliveira et al., 2013). An important feature of dual-mode theory suggests that the initial aversive responses are affective responses (i.e., basic response with little cognitive appraisal) rather than emotion or mood responses (Martinez et al., 2015). Meaning that although participants may be having an aversive response, the response is not necessarily long term.

Stork et al. (2018) conducted a repeated measures study that evaluated participants' affective responses to HIIT, MICT, and sprint-interval training (SIT) among inactive adults. The participants completed all three types of physical activity in a randomized order with each physical activity session occurring on a separate day. Despite elevated RPE and heart rate (HR) in HIIT and SIT, once the physical activity session was completed, there was no significant difference in participants' preference for HIIT, MICT, and SIT. This is especially interesting given these participants reported displeasurable affective responses in both HIIT and SIT during the session of physical activity which is consistent with dual-mode theory. In HIIT and SIT, participants affective responses became displeasurable towards the end of the workout, perhaps signifying the ventilatory threshold (VT) transition. However, participants who experienced a smaller drop in positive affective response during HIIT and SIT, were more likely to show a

higher preference for the two modes of physical activity. For HIIT, not only did individual's affective responses rebound post-physical activity, as dual-mode theory would suggest, there was also slight rebounds during the rest intervals (Stork et al., 2018). These findings indicate that although individuals may not always exhibit pleasurable responses to HIIT during the session of physical activity, they at least prefer it similarly to other forms of physical activity.

Oliveira et al. (2013) sought to examine the differences in affective response among 18-45 year old men who completed both HIIT and MICT in a randomized order. Participants completed the Felt Arousal Scale (FAS), which was used to measure participant's perceived activation stage, meaning high or low arousal. The participants reported a higher RPE and FAS for HIIT relative to MICT. However, FS was observed to be lower during the HIIT session relative to MICT, with some FS scores reported as displeasurable during the session of HIIT. The research team believed the displeasurable FS scores were due to the high rates of intensity and arousal experienced in the HIIT program. High intensity may lead the participants to surpass the VT resulting in using anaerobic metabolism, which creates an increase in displeasurable affect. The participants' FS responses to HIIT were consistent with dual-mode theory, as they displayed displeasurable affective responses during the workout but pleasurable responses immediately post-physical activity (Oliveira et al., 2013).

Self-Efficacy Theory

Self-efficacy theory suggests that an individual's choice of activity, and adherence to that activity, are based on their self-efficacy. In other words, people choose activities they believe they are capable of performing (Lim & Noh, 2017). Bandura (1977) theorized that one's emotional state and the strength of an individual's conviction in their effectiveness in any given task will affect whether they attempt a task at all. Furthermore, Bandura (1977) stated an

individual's perceived self-efficacy not only has an influence on an individual's choice of activity but can also impact their future success based off their expectations.

Treasure and Newberry (1998) examined if feeling states in response to HIIT and MICT influenced post-physical activity self-efficacy. Participants were randomized into the HIIT, MICT, or no physical activity control group. Participants completed the Exercise-Induced Feeling Inventory (EFI) to track their exercise feeling for both HIIT and MICT. Findings from this study suggest that an influential way to improve inactive, young adults' self-efficacy towards physical activity is through aversive stress. HIIT can accomplish this as it includes high intensity physical activity. However, the rest intervals could possibly prevent individuals from experiencing displeasurable affective responses to physical activity. The findings indicated that participants in the HIIT group reported a higher level of displeasurable affective responses during physical activity than the MICT group but reported a greater increase in self-efficacy after the bout of physical activity relative to the MICT group (Treasure & Newberry, 1998). This suggests that although individuals may experience a decline in pleasurable affect during high intensity physical activity, completion of the physical activity seemed to increase their self-efficacy. The findings from Treasure and Newberry (1998) are inconsistent with the findings of Decker and Ekkekakis (2010), who found significantly lower affect in participants in the HIIT condition relative to the MICT condition.

Video-Based Physical Activity Programs

Physical activity videos can be an accessible way to deliver physical activity interventions. Given the low physical activity rates, it is important that low-cost and accessible types of physical activity are available to the general population (Lox et al., 2016). For videos to be viewed as an effective method for physical activity, the experience does not need to be more

beneficial than in-person, but it does need to be comparable regarding impact One study compared the effectiveness of a fitness program delivered face-to-face or via DVDs. The study was designed using the community-based participatory approach with the weight loss portion of the intervention framed upon the Partnership for Improving Lifestyle Intervention (PILI) Lifestyle Program (PLP). The weight loss stage focused on staying motivated, problem solving, and continuing a healthy lifestyle during the holidays. The program found no significant differences between the two groups. Both groups showed high levels of physical activity maintenance and significant improvements in health-related outcomes (Ing et al., 2018). Another study examined the health-related and mental well-being impact of an at-home, 12-week physical activity program delivered via DVD relative to a control group among inactive, premenopausal women (Connolly et al., 2020). Researchers observed a high level of physical activity adherence in the intervention group relative to the control group. This indicates that this accessible mode of physical activity may be effective at healthy behavior change among inactive women. Additionally, the study observed significant, positive changes in the women's mental well-being and their cholesterol levels relative to the control group (Connolly et al., 2020).

One potential limitation with this type of intervention is the maintenance of the health impact once the intervention has ended. Blackwell et al. (2017) compared the effect of a four-week HIIT program delivered to participants in a lab and participants who completed the same program unsupervised, at home following along to videos. They found that both groups showed significant improvement in their cardiorespiratory fitness and compliance was 100% for both groups, meaning participants completed all assigned physical activity sessions while maintaining high intensity (Blackwell et al., 2017). The at-home HIIT intervention required no special equipment and only access to a screen was needed.

One potential concern regarding video-based physical activity programs is the lack of long-term adherence to a physical activity program that may occur. Roberts et al. (2017) examined the impact of a six-month, DVD-delivered physical activity program that targeted improving participant's flexibility, strength, and balance relative to a control group who received healthy aging DVDs with no physical activity component. They also examined the maintenance of the health improvements at an 18-month follow-up. The researchers found that the participants achieved significant improvements in their flexibility, strength, and balance in comparison to the control group, and maintained a significant amount of these improvements at the 18-month follow up while receiving no support from the research team after the initial six months (Roberts et al., 2017). These findings suggest that physical activity delivered through video can be as effective as physical activity delivered face-to-face and this effect can be maintained.

HIIT and Affective Response

Affective Response to HIIT

Given that physical activity adherence may be related to how enjoyable or tolerable a participant perceives physical activity (Ekkekakis et al., 2004), ensuring that individuals respond positively to physical activity is vital. For HIIT to be a viable intervention, it needs to produce pleasurable affective responses that are stronger than other forms of physical activity. However, research remains inconsistent if experiencing positive affect throughout the entirety of physical activity, as is suggested by hedonic theory, or if experiencing positive affect after a session of physical activity, as is suggested by dual-mode theory, is more important to adherence. Poon et al. (2018) randomly assigned insufficiently active healthy adults to one of three physical activity interventions and compared the affective responses to the interventions. The three different running sessions were HIIT, MICT and a vigorous-intensity continuous training (VICT)

program. The HIIT and VICT programs were 20 minutes in duration while the MICT program was 40 minutes in duration. Although participants' RPE and blood lactate levels were significantly higher in both the HIIT and VICT groups, HIIT produced a more pleasurable affective response in the young adults than it did in the MICT and VICT conditions (Poon et al., 2018). In fact, the participants reported a preference to participate in either HIIT or VICT rather than MICT, suggesting the elevated intensity was not necessarily a deterrent.

This finding contradicts the suggestions by Ekkekakis et al. (2004) who suggested that when individuals cross their VT into anaerobic metabolism, their affective responses become increasingly displeasurable, consistent with hedonic theory. The participants in Poon et al. (2018) exhibited higher RPE and blood lactate levels, which suggested they may have crossed their VT. However, these participants preferred the higher intensity activity over moderate intensity. Poon et al. suggested their finding may be due to the fact that previous research has not examined affective responses by age groups. Similarly, Thum et al. (2017) had participants complete both HIIT and MICT cycling conditions in a randomized order and measured their RPE, blood lactate, affective response, and preference after a bout of each session of physical activity. Although affect was lower in HIIT relative to MICT, the researchers found their participants significantly preferred HIIT to MICT (Thum et al., 2017).

Bartlett et al. (2011) examined participant's enjoyment assessed by the Physical Activity Enjoyment Scale (PACES) and RPE following physical activity sessions in high intensity interval running and moderate intensity continuous running. Participants were regularly active individuals who participated in both physical activity sessions in a randomized order. Participants reported more pleasurable scores in the high intensity session while also reporting higher RPE relative to the moderate intensity group (Bartlett et al., 2011). Studies by Bottoms et

al. (2019) and Hoekstra et al. (2017) reported similar findings revealing that despite participants perceiving HIIT as strenuous and with a less pleasurable affective response during the workout, participants reported a more pleasurable affective response to HIIT than MICT after completing the session of physical activity.

Martinez et al. (2015) examined the affective response of HIIT compared to VICT before, during, and after physical activity using the FS. Participants were randomized to three different sessions of running consisting of interval lengths of 30, 60, and 120 seconds. Participants completed all sessions in a randomized order with 48 hours between each session of physical activity. The participants significantly preferred the shorter interval trials relative to the longer interval trials (Martinez et al., 2015). This suggests that individuals experience greater levels of pleasure and enjoyment during shorter interval trials rather long interval trials or continuous exercise.

There are some studies that have contradicted the above findings. For example, Decker and Ekkekakis (2017) conducted a study comparing the affective responses to HIIT and MICT among women who were classified as obese. The women were randomized to determine which condition they would complete initially, as all eventually completed both conditions. Their findings suggested that FS scores decreased during both HIIT and MICT, but the scores were significantly lower during HIIT. Participants rated HIIT as significantly harder, less pleasant, and less enjoyable than MICT. Although the HIIT post-physical activity affective responses did rebound to similar levels as the MICT group, the displeasurable affective responses experienced during physical activity negatively influenced the participants' overall assessment of their experience with HIIT. The FS scores indicated that participants in the HIIT group crossed the VT into anaerobic metabolism. It is unclear if these findings would generalize to women of normal

weight given that women who are overweight and obese may cross the VT quicker than individuals at a healthy weight (Decker & Ekkekakis, 2017). The inconsistency in these findings suggest a need for further research in this area.

Potential Mechanisms for Affective Response to HIIT

Some studies suggest that HIIT is preferred to MICT (Bottoms et al., 2019; Hoekstra et al., 2017; Martinez et al., 2015; Oliveira et al., 2013); however, no studies have examined why this may be the case. Multiple authors have speculated as to why HIIT may be preferred. For example, Thum et al. (2018) hypothesized three potential explanation for why HIIT may be preferred. First, the intermittent nature of HIIT provides built in breaks for the participants, potentially alleviating the displeasurable affect experienced during physical activity. This belief is supported by Martinez et al. (2015) who hypothesized that the breaks act as a buffer to the displeasurable affective responses experienced by some during high intensity physical activity. Second, participants possibly view MICT as monotonous, and the constant activity change in HIIT keep participants entertained. This idea was also hypothesized by Hoekstra et al. (2017) who believed HIIT is effective in reducing boredom and increasing enjoyment. Finally, participants in HIIT may experience a sensation of accomplishment that does not occur with MICT. Poon et al. (2018) also hypothesized that individuals experience a sense of accomplishment during HIIT that is not common with other forms of physical activity. Determining the causes of affective responses during HIIT is an important next step for future studies.

Summary

As children transition into adulthood there is a significant decrease in their level of physical activity (USDHHS, 2018). This finding is supported by the fact that the majority of

adults from the United States do not meet physical activity guidelines (USDHHS, 2018). It is crucial that adults maintain an appropriate level of physical activity in order to promote their physical and mental health, quality of life, and physical function (USDHHS, 2018). This, and the clear need for low cost, accessible forms of physical activity (Lox et al., 2016), indicate physical activity among young adults who are transitioning from childhood to young adulthood must be studied. HIIT is a form of physical activity that is time-efficient and successful in producing positive health effects typically experienced in traditional cardiovascular physical activity (USDHHS, 2018). It can become even more accessible when it is delivered via video, which has been found to be a successful delivery mode of physical activity (Ing et al., 2018). Further research is needed that examines affective responses to HIIT and MICT when delivered through video through the theoretical lens of both hedonic theory and dual-mode theory, as no study has examined this. It will also be important for studies to examine the impact of different modalities of physical activity on psychosocial responses, such as affect, exercise feeling, enjoyment, self-efficacy, and arousal. These findings would have important implications for creating physical activity programs that would help individuals maintain their levels of physical activity as they transition into adulthood.

Purpose and Hypotheses

Study Rationale

This study addressed the inconsistent literature and theoretical constructs examining the impact of high intensity interval training (HIIT) on participants' affective responses relative to continuous moderate intensity activity (MICT). Some studies have found that participants report more positive affect, consistent with hedonic theory, in response to HIIT while others have not found this effect (Ekkekakis et al., 2004; Poon et al., 2018). Specifically, Poon et al. (2018) found that participants responded with higher rates of pleasure to HIIT when compared to MICT and expressed a greater preference for HIIT relative to MICT. Likewise, Bartlett et al. (2011) measured individuals' affective response to HIIT and MICT and found that participants reported higher rates of positive affect in response to HIIT relative to MICT.

Conversely, Ekkekakis et al. (2004) observed that individuals report negative affect when crossing their VT into anaerobic metabolism. This finding was supported by Decker and Ekkekakis (2017), who observed participants affective responses while completing sessions of both HIIT and MICT. Participants reported greater displeasure during HIIT relative to MICT but reported similar levels of positive affect and a preference for HIIT at the conclusion of the physical activity sessions, which is consistent with dual-mode theory.

Previous studies comparing the psychological impact of HIIT relative to MICT utilized either cycling (Decker & Ekkekakis et al., 2017; Hoekstra et al., 2017; Martinez et al., 2015; Thum et al., 2018) or treadmill running (Bartlett et al., 2011; Nybo et al., 2010; Oliveira et al., 2013; Poon et al., 2018) as the mode of physical activity. To our

knowledge, no previous studies have examined the psychological impact of HIIT relative to MICT when both conditions included varying exercises within a group-based fitness setting. It is possible that varying the exercises during the session influences affective responses relative to completing the same exercise (e.g., biking) throughout the session (Hoekstra et al., 2017).

The capability of live, online delivery of physical activity is a useful tool that can be used to address barriers to physical activity such as time, transportation, and childcare. Studies indicate that conducting physical activity sessions via video can be as effective in improving participants' health relative to conducting sessions in-person (Blackwell et al., 2017; Connolly et al., 2020; Roberts et al., 2017). Given the novelty of live, online delivery of physical activity, there are no previous studies examining affective responses to HIIT relative to MICT conducted online.

The purpose of this study was to examine affective responses to HIIT relative to MICT delivered via online conferencing. Participants responded to questionnaires regarding their demographic information, current exercise behaviors, reasons for exercise, future intention to exercise, affect, enjoyment, and rate of perceived exertion before and after participating in HIIT or MICT.

Specific Aims and Hypotheses

Specific Aim One

To examine the effect of High Intensity Interval Training (HIIT) relative to Moderate Intensity Continuous Training (MICT) on exercise feeling, enjoyment, arousal, self-efficacy, and future intentions to exercise.

Related Hypothesis. Participants randomly assigned to the HIIT session will report higher levels of exercise feeling, enjoyment, arousal, and self-efficacy relative to participants in the MICT condition after controlling for pre-test levels of these variables.

Specific Aim Two

To examine the effect of HIIT on participants' affect during and after HIIT relative to MICT.

Related Hypothesis. Participants randomly assigned to HIIT will report more positive affective responses during and after the session relative to participants in MICT.

Exploratory Aims

To explore the relationship between reasons for exercise and exercise feelings regardless of condition assignment. Also, to explore the relationship between exercise feeling and affect with self-efficacy.

Method

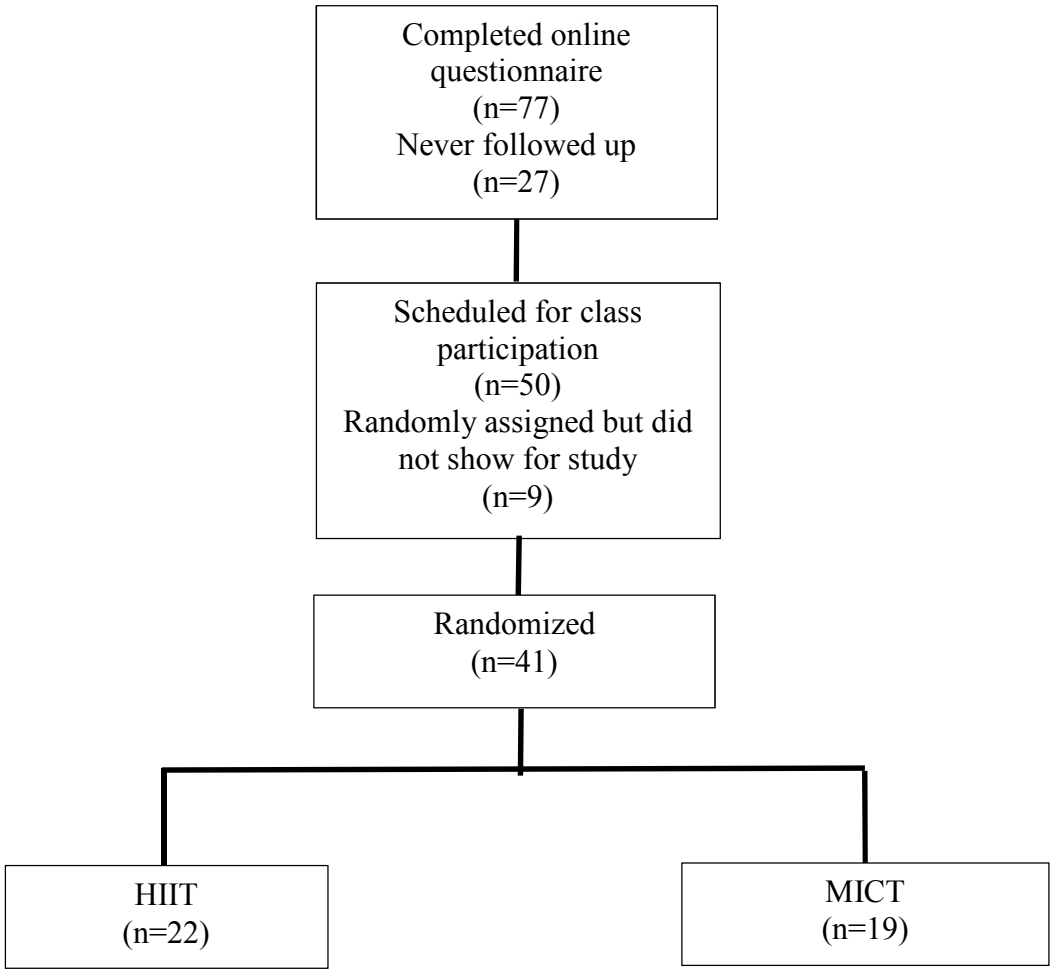
Participants

Participants were enrolled at a large, public, Midwestern university and were recruited from undergraduate kinesiology classes. Recruitment took place from December 2020 through February 2021. Participants were recruited directly through undergraduate Kinesiology courses. The study was advertised as investigating how one's affective responses to a 25-minute session of High Intensity Interval Training (HIIT) compared to affective response to a session of 25-minute MICT (Appendix A). The inclusion criteria was a convenience sample of college-aged students who were capable of completing a 25-minute physical activity class.

A screening questionnaire (Appendix C) determined if potential participants were eligible for the study. A total of 77 individuals completed the pre-screening questionnaire. Participants who were deemed eligible after completing the pre-screening questionnaire were randomly assigned to either the HIIT or MICT class once they reported their availability. Since all participants who completed the pre-screening questionnaire were eligible to participate, the 50 participants who reported their availability were then given a time to participate in their assigned class (HIIT, n=26; MICT, n=24). Of the 50 participants who were scheduled to participate in a class, nine did not come to their assigned class. Therefore, 41 individuals participated in either the HIIT (n=22) or MICT (n=19) class (see Figure 1). All participants (n=41) completed the consent form (Appendix D) prior to the beginning of their assigned class. The study was approved by the Institutional Review Board (Appendix A).

Figure 1

Flow of participants from December 2020 - February 2021



Measures

Participants were asked to complete a series of questionnaires before, during, and after their participation in a session of either HIIT or MICT. The measures included demographic information, general attitude towards physical activity, and exercise-induced feelings.

Demographics. Participants completed demographic questionnaires regarding their age, gender identity, sexual orientation, and average physical activity minutes per week.

Affective Response. Participants' affective responses to physical activity were measured using the FS (Hardy & Rejeski, 1989; Appendix E). The FS asks participants how they are feeling and how much they are enjoying or enjoyed exercise. The FS is only two items and therefore, can be administered before, during, and after exercise. The participants rated their current feeling as part of the FS-current using a scale of -5 to +5, with a higher score indicating higher levels of positive affect. They rated their enjoyment as part of the FS-enjoyment on a scale of 1-7, with higher scores reflecting higher enjoyment. The FS is reliable for assessing in-exercise affect (Hardy & Rejeski, 1989).

Exercise Feeling. Participants completed the EFI (Appendix E), which assessed participants' exercise feeling before and after a class (Gauvin & Rejeski, 1993). The 12-item questionnaire instructs participants to, "Indicate how each word describes how they feel at this moment in time…" The participants then rated how they felt on a scale of 0-4 with a higher score indicating the participant is "feeling very strongly," whereas, the lower scores indicating the item is "not felt," Examples of the words participants rated were "refreshed," "worn out," and "energetic." The EFI is scored by summing the four subscales, which include revitalization, physical exhaustion, positive engagement, and tranquility. The four subscales each consist of three items. The EFI has demonstrated good internal consistency and reliability (Gauvin & Rejeski, 1993).

Self-efficacy. Physical activity self-efficacy was assessed using the 10-item Exercise Self-Efficacy Scale (ESES; Appendix E; Bandura, 1977). Participants were directed to respond "how confident" they were in their ability to partake in and complete a session of physical activity. Examples of the ten items include, "That I can overcome barriers and challenges with regard to physical activity and exercise if I try hard enough"

and “that I can be physically active or exercise even without the support of my family or friends.” Participants rated their responses on a 1-4 scale, with a higher score indicating a scenario is more likely to be true, and a lower score indicating a lower likelihood that the scenario is true for the participant. The total score is calculated by summing the responses to each question. A higher score indicates higher self-efficacy for exercise. This scale has been shown to have acceptable reliability and validity among different populations (Mendoza-Vasconez, 2018).

Physical Activity Enjoyment. To measure participants’ physical activity enjoyment, the PACES (Kendzierski & DeCarlo, 1991), was used. The PACES (Appendix E) is an 18-item measure directing participants to “measure how they feel about physical activity at this moment in time…” Participants rated how they feel about various items relating to physical activity on a 1-7 scale with 1 and 7 reflecting opposite ends of the spectrum. For example, the two anchors for the first item are, “I enjoy it” and “I hate it.” In this example, a one aligns with “I enjoy it” and a seven aligns with “I hate it.” Eleven of the items are reversed scored. Higher scores indicate higher enjoyment of physical activity (Kendzierski & DeCarlo, 1991).

Activation State. To measure participants’ perceived activation state before and after a session of physical activity, the FAS (Svebek & Murgatroyd, 1985) was used. The FAS (Appendix E) asks participants to mark on a scale to indicate their level of activation and pleasure. For example, the scale describes to the participants where to mark if they are experiencing pleasure or displeasure or if they are experiencing high or low activation. The scale has numbers corresponding with the chart that can be used to assign

scores to the participants' mark. The FAS has been shown to have convergent ability with other physical activity activation measures (Svebek & Murgatroyd, 1985).

Physical Activity Level. To measure participants' level of physical activity, the Leisure Time Exercise Questionnaire (LTEQ; Godin & Shepherd, 1985; Appendix E) was used. The questionnaire asks participants to consider, on average, how many times per week they complete 15 consecutive minutes or more of either strenuous, moderate, or mild exercise. Strenuous exercise is defined as the heart beating rapidly and running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, and vigorous biking are listed as example activities. Moderate exercise is defined as not exhausting and has fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, and dancing as example activities. Mild exercise is defined as minimal effort and lists yoga, archery, fishing, bowling, horseshoes, golf, snowmobiling, and easy walking as sample activities. The score is calculated by multiplying the time spent engaging in strenuous, moderate, or mild activity with the number of METs associated with each intensity level (strenuous: 9; moderate: 5; mild: 3), and then summing the three intensity levels. A score greater than 24 reflects a higher physical activity level, 14-23 indicates a moderate physical activity level, and 13 or less indicates low or insufficient levels of physical activity (Godin, 2011). This questionnaire has been found to have high validity (Godin, 2011).

Exercise Motivation. Participants completed the Reasons for Exercise Inventory (REI; Silberstien et al., 1998; Appendix E) to assess their motivation to partake in physical activity. The REI has been linked to affect in previous research (LePage & Crowther, 2010). The form begins by explaining that individuals exercise for numerous

reasons and asks participants to mark, “to what extent of the following reasons are important for you exercising.” The form then instructs participants to indicate their response by circling the number that most closely corresponds to their belief on a one (not at all important) to seven (extremely important) scale. Examples of prompts include, “I want to be slim,” “to increase my energy level,” and “to be attractive to others.” There seven motives that encapsulate all 24 items. The seven items are: Weight control, attractiveness, body tone, health, fitness, enjoyment, and mood improvement. In accordance with previous research (O’Hara et al., 2014; Strelan et al., 2003), the seven motives were collapsed into three domains: Appearance reasons (weight control, attractiveness, body tone), enjoyment/mood, and health/fitness. In this study, the seven motives were also collapsed into three categories. Higher scores in each category indicate greater motivation to exercise for those reasons. The REI has demonstrated high internal consistency in previous studies (O’Hara et al., 2014; Strelan et al., 2003).

To measure participants’ anticipated desire to be physically active in a session similar to the one in the intervention, the Future Intention to Exercise questionnaire (O’Hara et al., 2014; Raedeke et al.,2007; Appendix E) was used. This questionnaire is a single question that asks participants to rate the likelihood (1-100%) that they plan to complete another session of physical activity similar to the one they completed for the study.

Rate of Perceived Exertion. To measure participants’ perceived exertion, the RPE (Borg & Ottoson, 1986; Appendix E) was used. RPE has been linked to affect in previous studies (Acevedo et al., 1994). Participants reported their perceived exertion level during physical activity using a 6-20 scale with lower numbers representing less

exertion and a higher number representing greater exertion. The scale includes descriptors of the levels to improve participants' understanding of the levels. For example, level six represents "no exertion at all" and level 17 would be considered "very hard." The RPE scale has been shown to be a valid measure of perceived exertion in physical activity among healthy individuals (Chen et al., 2002).

Table 1

Measure and data collection time points

Measure	Variable	Pre	Mid	Post
Exercise-Induced Feeling Inventory	Affect	X		X
Feeling Scale	Affect	X	X	X
Exercise Self-Efficacy Scale	Self-efficacy	X		X
Physical Activity Enjoyment Scale	Enjoyment	X		X
Felt Arousal Scale	Perceived arousal	X		X
Leisure Time Exercise Questionnaire	Physical activity	X		
Reasons for Exercise Inventory	Exercise motivation	X		
Future Intention to Exercise Scale	Future motivation	X		X
Rate of Perceived Exertion Scale	Perceived exertion		X	

Procedures

Participants were recruited directly through undergraduate Kinesiology courses. This occurred through a message on the students' course website or through a recorded video. Participants who learned about the study through their course website had access to the pre-screening questionnaire link and could fill it out immediately. Participants who saw the recruitment video reached out to the lead researcher to get access to the link for the pre-screening questionnaire. Once the pre-screening questionnaire was completed, the students reached out to the lead researcher to learn if they were eligible and if eligible to be assigned to a class.

Recruitment and Eligibility Screening

Participants were recruited through email, online/in-class advertisement, and word of mouth (Appendix B). The recruitment materials presented the study as an investigation of participants' affective responses to a 25-minute session of HIIT relative to a 25-minute session of MICT.

Individuals who were interested in being a participant completed the pre-screening questionnaire to determine their eligibility to participate in the study. The pre-screening questionnaire assessed basic demographic information and the exclusion criteria including the following: (1) Pregnancy; (2) not able to read and write in English; and (3) instructed by a health professional to not exercise.

Randomization

After completing the screening, if participants were deemed eligible, they were given information to join the Zoom session for the actual intervention. Participants who met the inclusion criteria were randomized 1:1 by the lead researcher to either the HIIT or MICT physical activity session once they had completed the pre-screening questionnaire. Since the two classes were not held at the same time, the participants had to be randomized prior to participation.

Class setting

All classes (both MICT and HIIT) were held via online conferencing (i.e., Zoom platform). To hold a class, there had to be at least three participants to provide a sense of group participation. The participants could participate in the class from anywhere as long as they had an appropriate amount of space to complete the class.

Pre-Class Questionnaire Administration

Prior to their assigned class, participants were emailed the class information for their assigned class, a Zoom link for them to access the class, and the information needed for them to calculate their Target Heart Rate zone for their assigned class. Once the participants were logged into Zoom, they were given an ID number for the questionnaires and provided an overview of what to expect for the class. Following this, they were sent the link to the pre-class questionnaire to complete, which took approximately 15 minutes to complete. Participants were told to ask any questions they had and to message the researcher via Zoom chat when they were done.

Class Procedures

Once participants completed the pre-class questionnaire, they were instructed to prepare for the beginning of their workout by having the appropriate amount of space, a paper and pencil nearby to track their heart rate, and their camera on with the mute feature on. Participants were shown a HIIT or MICT video through Zoom, which were created by an American College of Sport Medicine Exercise Physiologist®. The class consisted of a five-minute warm up, 20-minute body weight HIIT or body weight MICT, and five-minute cool down. The same video was used for all HIIT and MICT sessions to ensure all participants were exposed to the same workout.

Mid-Workout Questionnaire Administration

During the HIIT and MICT class, the video was paused twice to administer the mid-workout questionnaire. The two pauses for the HIIT class took place at 17:47 and 22:56. The two pauses for the MICT class took place at 18:00 and 23:01. The first pause coincided with the conclusion of a break halfway through the workout, while the second pause coincided with the beginning of a break roughly two-thirds of the way through the

workout. The mid-workout questionnaire took one to two minutes for the participants to complete.

Post-Class Questionnaire Administration

Following the class, participants were sent the link to the post-class questionnaires. They were informed they could ask any questions they may have and that they did not need to stay on the Zoom call to complete the questionnaire. They were told that once Qualtrics showed that the entire class had completed the questionnaire, an email was sent to the students that could be forwarded to their professors to obtain extra credit for their kinesiology course.

Data Analysis

After the completion of data collection in February 2021, data were entered into SPSS and screened for missing data. Since the questionnaires were collected via Qualtrics, no questions were left unanswered as responses to all questions were required before the questionnaires could be submitted. Descriptive analysis of the demographic questionnaires was conducted.

Specific Aim Analysis One

A between groups univariate analysis was conducted to examine the effect of condition assignments (HIIT vs. MICT) on exercise feeling, enjoyment, arousal, self-efficacy.

Specific Aim Analysis Two

A between groups univariate analysis was conducted to examine the effect of condition assignment on affect during and after HIIT relative to MICT.

Exploratory Aim Analysis

A linear regression analysis was used to determine if reasons for exercising predicted feelings about exercise. For the second exploratory aim, a linear regression analysis was used to determine if affect and feelings about exercise predicted self-efficacy for exercise.

Results

The internal consistency reliability for the questionnaires is reported on Table 2. Using an alpha of α=0.6, all questionnaires, and therefore all variables, were deemed reliable and included for the final analysis.

Table 2

Internal consistency reliability for questionnaires

Scale	Item	Cronbach's Pre-Test	Cronbach's Post-Test
EFI-Positive Engagement	*3*	*0.69*	*0.65*
EFI-Revitalization	*3*	*0.67*	*0.72*
EFI-Physical Exhaustion	*3*	*0.75*	*0.88*
EFI-Tranquility	*3*	*0.88*	*0.77*
Exercise Self-Efficacy Scale	*10*	*0.82*	*0.90*
Physical Activity Enjoyment Scale	*18*	*0.88*	*0.91*
Reasons for Exercise Inventory	*24*	*0.78*	*0.82*

Notes: EFI=Exercise-induced Feeling Inventory.

Recruitment

The majority of randomized participants were recruited through an in-class advertisement or an email sent from their professor/instructor in the School of Kinesiology (Table 3). The minimum number of three participants was needed to conduct a physical activity session. If it was not possible to have three participants on the Zoom physical activity session, the class was not held. The eight sessions ranged from three to nine participants with a mean of 5.13 participants (SD=1.83). A between subjects'

ANOVA revealed no significant differences between the HIIT and MICT conditions on size of classes.

Table 3

Methods of recruitment

Recruitment Method	Screened (n=77)	Final Sample (n=41)
Email	24	13
In-class	48	25
Other	5	3

Demographics

The final sample consisted primarily of Caucasian, young adult females from a large Midwestern university. The characteristics of the participants are depicted in Table 4. Between subjects' ANOVA tests revealed no significant differences between the two conditions on the demographic and other baseline variables including: Age, gender, race, ethnicity, exercise habits, exercise experience, UWRC membership, LTEQ score, and REI scores.

Table 4

Participant characteristics

Characteristic	Total (n=41)	HIIT (n=22)	CT (n=19)	P-Value
Age	20.51 (1.94)	20.00 (.98)	21.11 (2.56)	0.07
Gender (%)				0.49
Female	0.68	0.77	0.58	
Male	0.32	0.23	0.42	
Race (%)				0.06
White	0.76	0.64	0.90	
Non-white	0.24	0.36	0.11	
Ethnicity (%)				0.28
Hispanic	0.03	0.00	0.05	
30 minutes of exercise %	0.71	0.73	0.68	0.76

Previous HIIT Experience %	0.68	0.64	0.74	0.49
Current UWRC Member %	0.66	0.73	0.58	0.32
LTEQ Score, mean (SD)	44.67 (22.00)	49.23 (24.31)	38.77 (17.55)	0.32
REI-Enjoy/Mood, mean (SD)	5.20 (1.10)	5.20 (1.25)	5.20 (0.94)	0.65
REI-Health/Fitness, mean (SD)	7.09 (1.00)	7.15 (0.94)	7.03 (1.20)	0.38
REI-Appearance Reasons mean (SD)	4.29 (1.24)	4.47 (1.13)	4.08 (1.35)	0.43

Notes: LTEQ=Leisure Time Exercise Questionnaire. UWRC=University Recreation and Wellness Center. REI=Reasons for Exercise Inventory. Figures are reported as percentages and means with standard deviations in parentheses.

The majority of participants (70.7%) indicated they exercised for 30 minutes at least three times per week. A large number of participants (68.3%) reported having participated in a HIIT workout prior to this study. There was no significant difference between the HIIT and MICT group on any of the Reasons for Exercise subscales.

Specific Aim One

There were no significant differences of condition assignment on positive engagement, revitalization, and tranquility subscales on the EFI, PACES, FAS, or ESES when controlling for pre-class scores (see Table 5). There was a significant difference for the EFI physical exhaustion subscale, $F(1, 38)=27.596$, $p<.001$, in that participants in the HIIT session reported higher levels of exhaustion relative to participants in the MICT session after controlling for pre-class scores. Participants in the HIIT condition reported significantly higher RPE, $F(8, 41)$, $p<.01$, relative to the MICT.

Table 5

Descriptive statistics for the EFI subscales, PACES, FAS, and ESES over time by condition.

			Pre		Post	
Variable	Condition	Possible Range	M	(SD)	M	(SD)

EFI-Positive Engagement		0 - 12				
	HIIT		7.27	(2.10)	7.82	(1.59)
	MICT		6.47	(2.29)	7.90	(2.08)
	Total		6.90	(2.20)	7.85	(1.81)
EFI-Revitalization		0 - 12				
	HIIT		6.00	(2.33)	7.14	(2.49)
	MICT		5.21	(2.37)	7.05	(2.09)
	Total		5.63	(2.35)	7.10	(2.29)
EFI-Physical Exhaustion		0 - 12				
	HIIT		3.86	(2.46)	6.00	(2.76)
	MICT		3.11	(2.33)	1.90	(1.88)
	Total		3.57	(2.40)	4.10	(3.15)
EFI-Tranquility		0 - 12				
	HIIT		8.00	(3.21)	6.18	(2.46)
	MICT		6.00	(2.36)	6.95	(2.70)
	Total		7.07	(2.99)	6.54	(2.57)
PACES		18 - 126				
	HIIT		103.27	(16.31)	101.32	(16.79)
	MICT		101.26	(14.97)	104.53	(17.66)
	Total		102.34	(15.54)	102.81	(17.06)
FAS		1 - 6				
	HIIT		3.36	(1.09)	3.77	(1.02)
	MICT		2.95	(1.27)	3.32	(1.11)
	Total		3.17	(1.18)	3.56	(1.07)
ESES		10 - 40				
	HIIT		32.77	(4.69)	33.14	(5.29)
	MICT		33.58	(3.76)	35.21	(4.17)
	Total		33.15	(4.25)	34.10	(4.86)

Notes: EFI= Exercise-Induced Feeling Inventory. PACES=Physical Activity Enjoyment Scale. FAS=Felt Arousal Scale. ESES=Exercise Self-Efficacy Scale. Standard deviations are listed in parentheses.

Specific Aim Two

When controlling for the pre-class scores, there were no differences between HIIT and MICT on the FS-current measure during the first mid-class or post-class ratings. However, participants in the HIIT condition did report significantly less pleasure relative to the MICT condition during the mid-class second rating, $F(1, 38)=7.503$, $p<.01$. The

FS-enjoyment question indicated no significant differences between the two conditions at any of the timepoints.

Table 6

Descriptive statistics for FS-current and FS-enjoyment over time by condition

		Pre		Mid #1		Mid #2		Post	
Variable	Condition	M	(SD)	M	(SD)	M	(SD)	M	(SD)
FS-Current (Range: -5-5)									
	HIIT	2.32	(2.03)	2.14	(1.75)	1.95	(2.19)	2.68	(1.84)
	MICT	2.37	(1.86)	3.42	(1.68)	3.53	(1.71)	3.11	(1.73)
	Total	2.34	(1.93)	2.73	(1.82)	2.68	(2.12)	2.88	(1.78)
FS-Enjoyment (Range: 1-7)									
	HIIT	4.23	(1.27)	2.32	(1.64)	2.14	(1.83)	4.86	(1.17)
	MICT	4.16	(1.12)	2.63	(1.71)	2.79	(1.51)	4.63	(1.30)
	Total	4.20	(1.19)	2.46	(1.66)	2.44	(1.70)	4.76	(1.22)

Notes: FS=Feeling Scale. HIIT=High Intensity Interval Training. MICT=Moderate Intensity Continuous Training.

Exploratory Aim One

The linear regression examining if the reasons for exercise predicted feelings about exercise (both assessed prior to the physical activity session) is summarized in Table 7. The overall linear regression model examining the relationship between the REI variables and EFI-Tranquility approached significance, R^2=.159, p=.091. Specifically, higher REI-Health/Fitness related to higher tranquility. REI Enjoy/Mood had a significantly inverse relationship with tranquility. There was no effect of REI on the other three subscales.

Table 7

Reasons for Exercise Inventory Predicting Exercise-Induced Feeling Inventory

EFI Positive Engagement			
Independent Variables	Beta	t-value	Sig.
REI-Appearance Reasons	0.30	1.88	0.07
REI-Health/Fitness	0.20	1.09	0.28
REI-Enjoy/Mood	-0.07	-0.41	0.68
EFI Revitalization			
Independent Variables	Beta	t-value	Sig.
REI-Appearance Reasons	0.15	0.90	0.38
REI-Health/Fitness	0.01	0.04	0.97
REI-Enjoy/Mood	0.15	0.78	0.44
EFI Physical Exhaustion			
Independent Variables	Beta	t-value	Sig.
REI-Appearance Reasons	-0.08	-0.48	0.64
REI-Health/Fitness	-0.00	-0.01	0.99
REI-Enjoy/Mood	-0.01	-0.04	0.97
EFI Tranquility			
Independent Variables	Beta	t-value	Sig.
REI-Appearance Reasons	0.04	0.24	0.81
REI-Health/Fitness	0.40	2.24	0.03
REI-Enjoy/Mood	-0.38	-2.15	0.04

Notes: REI=Reasons for Exercise Inventory. EFI=Exercise-Induced Feeling Inventory.

Exploratory Aim Two

The linear regression analyses examining if exercise feelings and affect predicted exercise self-efficacy is summarized in Table 2. The overall linear regression model examining the effect of exercise feelings and affect on ESES was significant, R^2=.408, p<.01. Specifically, higher EFI-Revitalization and FS-Enjoyment were related to higher exercise self-efficacy. Additionally, EFI-Positive Engagement had a significant inverse relationship with exercise self-efficacy.

Table 8

Exercise-Induced Feeling Inventory and Feeling Scale Predicting Exercise Self-Efficacy Scale

ESES

Independent Variables	Beta	t-value	Sig.
EFI-Positive Engagement	-0.43	-2.31	0.03
EFI-Revitalization	0.55	2.46	0.02
EFI-Physical Exhaustion	0.07	0.42	0.68
EFI-Tranquility	-0.02	-0.12	0.91
FS-Current	0.11	0.50	0.62
FS-Enjoyment	0.36	2.09	0.05

Notes: FS=Feeling Scale. EFI=Exercise-induced Feeling Inventory. ESES=Exercise Self-Efficacy Scale.

Discussion

Specific Aim One

Exercise Feeling

As expected, participants in the HIIT condition reported higher levels of physical exhaustion than participants in the MICT condition. Contrary to our hypothesis, there was no effect of condition assignment on the other types of exercise feeling (i.e., positive engagement, revitalization, and tranquility). These findings are consistent with dual-mode theory and another study which found that although participants may interpret HIIT as significantly more intense, they experience similar levels of positive engagement, revitalization, and tranquility relative to MICT (Tuuri, 2014). Participants in the HIIT condition reported higher RPE ratings relative to the MICT condition, indicating that despite higher intensity ratings, there was no effect on positive engagement, revitalization, and tranquility.

Enjoyment

Contrary to the hypothesis, no significant differences between the two conditions emerged between the post-class enjoyment scores, when controlling for pre-class scores. This is inconsistent with previous studies, which have found that physical activity performed in intervals resulted in greater enjoyment relative to MICT (Bartlett et al.,

2011; Hoekstra et al., 2017; Martinez et al., 2015; Thum et al., 2018). There are some possible explanations for why enjoyment did not differ between the MICT and HIIT. For example, Martinez et al. (2015) found that HIIT that had intervals of physical activity that were overly long or intense reduced the enjoyment experienced by participants. It is possible the HIIT for the present study may have had intervals that were too intense given the increased physical exhaustion and perceived exertion reported in the HIIT condition relative to the MICT condition.

Additionally, Hoekstra et al. (2017) observed that including variation in physical activity leads to greater enjoyment of physical activity. Both the MICT and HIIT in this study had variation of exercises, although there was more variation of exercises in the HIIT condition. Varying types of exercises in both conditions could have contributed to the similarities in enjoyment that were observed given previous studies used only one activity for the MICT condition (e.g., continuous cycling). The present study builds on literature in this area as it utilized a physical activity format typically used in group fitness classes. To do this, both HIIT and MICT included exercise variation to control for disparities between the two conditions.

Arousal

There was no significant difference between HIIT vs. MICT on arousal. This is inconsistent with the hypothesis that the HIIT condition would experience significantly greater levels of arousal than the MICT condition. This contrasts to previous research, which has observed higher levels of arousal among individuals who participate in HIIT relative to MICT (Oliveira et al., 2013; Stork et al., 2018).

There are possible explanations for this disparity. Both Oliveira et al. (2013) and Stork et al. (2018) found significantly greater arousal during and after the physical activity. Arousal was not measured during the mid-workout questionnaire in the present study as we tried to limit the amount of time required to complete the mid-workout questionnaires to not drastically disrupt the flow of the physical activity session. Perhaps, significant differences would have been observed during physical activity for the present study if arousal had been assessed at this timepoint.

Self-Efficacy

Similar to enjoyment, there were no significant differences between conditions on exercise self-efficacy when controlling for pre-class scores. This was opposed to the hypothesis. The effect of HIIT vs. MICT on self-efficacy has been mixed in previous studies (Ekkekakis, 2010; Poon et al., 2018). For example, Poon et al. (2018) found that among younger adults, level of self-efficacy was similar among participants who completed HIIT relative to MICT; however, in older adults, self-efficacy was significantly lower in HIIT relative to MICT. Treasure and Newberry (1998) observed that higher self-efficacy was related to positive affect in high intensity physical activity, but not in low intensity physical activity. The sample in the present study consisted of younger adults, which may have led to the similarities between conditions, as was observed in Poon et al. (2018).

Specific Aim Two

Affect

The hypothesis that participants in the HIIT condition would experience greater levels of positive affect during and after the session relative to the MICT condition was

not supported. Previous research has reported mixed results in this area. Specifically, Decker and Ekkekakis (2017) observed significantly less positive affect among low-active women with obesity who completed HIIT versus MICT. Oliveira et al. (2013) observed that positive affect was significantly lower in HIIT relative to MICT, but then rebounded to similar levels post-session. Martinez et al. (2015) observed similar levels of positive affect in HIIT relative to MICT when the intervals were shorter in duration. However, when the intervals were longer, positive affect was lower in HIIT relative to MICT. Poon et al. (2018) noted that in young adults, HIIT resulted in positive affect during and post physical activity relative to MICT.

In the present study, during the second mid-class rating, HIIT was reported as significantly less pleasurable than MICT. This is similar to the findings from Oliveira et al. (2013), who found that participants reported less pleasure during HIIT before experiencing a rebound in positive affect post-session. This was also observed in the present study as the post-session affect revealed no significant differences in the HIIT condition relative to the MICT condition. The reduction in positive affect could potentially be explained by the study from Martinez et al. (2015), which observed that once participants crossed the ventilatory threshold, positive affect was significantly reduced. This finding regarding affect being negatively impacted by crossing the ventilatory threshold is consistent with other studies (Decker & Ekkekakis, 2017; Ekkekakis et al., 2004; Poon et al., 2018; Thum et al., 2017). It is possible that participants in the HIIT condition crossed the ventilatory threshold while the MICT condition did not.

Similar to the present study, Oliveira et al. (2013) and Martinez et al. (2015) observed that HIIT and MICT resulted in similar levels of positive affect despite HIIT being significantly more intense. It appears, that when used with the correct group of individuals, HIIT can result in similar affect despite the elevated intensity. However, this finding is not congruent across all age groups given Poon et al. (2018) and Decker and Ekkekakis (2017) observing lower levels of positive affect in HIIT relative to MICT when working with older adults.

Exploratory Aim One

Exercising for enjoyment and mood reasons predicted participants' tranquility in exercise. Enjoyment and mood had an inverse relationship with tranquility. The inverse relationship can potentially be explained by the idea that those who are motivated to exercise by enjoyment and mood have high expectations of experiencing enjoyment and positive mood, and when those expectations are not met, tranquility is reduced. Furthermore, participants who exercise for health and fitness reasons predicted greater levels of tranquility. The positive relationship can potentially be explained by the idea that those who are motivated to exercise for health and fitness reasons will experience a sense of tranquility once those desires have been fulfilled. No previous research has examined the relationship between exercise feeling and reasons for exercise.

Exploratory Aim Two

Participants reporting higher levels of positive affect and revitalization from exercise reported higher levels of self-efficacy, which is partially consistent with self-efficacy theory. Specifically, participants' exercise feelings of revitalization and affective enjoyment were associated with greater self-efficacy. This can potentially be explained

by the idea that experiencing enjoyment and feeling revitalized during physical activity can increase one's perceived ability to adhere to physical activity moving forward. Additionally, participants' positive engagement had an inverse relationship with self-efficacy. Since these assessments were taken pre-physical activity, participants' sense of positive engagement may have been low. With this, their self-efficacy in completing their session of physical activity may have remained high even with a drop in their positive engagement. No previous research has examined the relationship between exercise feeling and affect with exercise self-efficacy.

Strengths of Study Design

This study had several strengths. First, the study included a randomized design and validated measures. Second, the HIIT and MICT sessions were designed and conducted by an American College of Sport Medicine Exercise Physiologist®. Additionally, several factors were controlled for between the two conditions including the same instructor was used, the exercises were varied in each condition, and the delivery model was the same (i.e., online delivery). Third, this study is one of the first to deliver a workout via video with live, online participants when observing the impact of HIIT relative to MICT. Finally, affect was assessed during exercise in addition to before and after the physical activity sessions.

Study Limitations

There were several limitations to this study. First, the study population lacked ethnic, gender, and racial diversity, therefore limiting generalizability of findings. Second, the study population was highly active. The average LTEQ score was 44.67 and a score over 24 is considered to be active resulting in substantial health benefits. This

suggests that the participants were a highly active group. Therefore, the findings do not generalize to inactive individuals, which is the norm. Fourth, the sample size was small and therefore, it is possible that the lack of differences between conditions was due to low power. Finally, this is the first study that has used these specific HIIT and MICT classes, so it is possible that the structure or intensity of the classes were not consistent with previous studies.

Future Research Directions

The limitations of the current study indicate a need for future research in this area that includes a more representative group of individuals in this age group including more diversity in gender, race, and ethnicity. A larger sample could potentially provide clarification on the inconsistencies that exist in the literature when observing the effect of HIIT and MICT on affective responses. Future studies could also compare the efficacy of live, online delivery of physical activity relative to in-person sessions. Additionally, HIIT is often touted as providing positive health benefits with less required time, so future studies should examine affect in HIIT vs. MICT with shorter sessions of HIIT relative to MICT. Finally, future studies could observe affect, exercise feeling, enjoyment, arousal, and self-efficacy over multiple sessions of HIIT relative to MICT.

Practical Implications

The current findings have important implications for fitness professionals who work with young, active adults. Many young people are looking for physical activity that is quick, effective, and enjoyable. The present study suggests that HIIT can be a useful form of physical activity to address these needs. Participants' reported level of enjoyment and intent to participate in similar sessions of physical activity was similar between

conditions. This affirms that HIIT is an appropriate style of physical activity for this group, and that they will enjoy it comparably to other alternatives despite the increased intensity.

Fitness professionals should be aware of the greater levels of physical exhaustion experienced in HIIT relative to MICT. This, and the significantly lower affect observed mid-workout in HIIT relative to MICT, suggests fitness professionals should be in constant communication with clients to understand how they are feeling. This is an especially important consideration as it was observed that positive affect was associated with higher exercise self-efficacy. To ensure that participants maintain their physical activity, fitness professionals need to design and adjust physical activity, so it leads to long-term adherence.

Conclusion

The majority of the United States population does not meet physical activity recommendations (USDHHS, 2018). Due to this, many face health complications that could be offset by reaching the recommended levels of physical activity. Young adulthood is a common point in life in which a large decrease in physical activity is observed (Lox et al., 2016), making physical activity interventions particularly relevant for this age group.

This study examined the impact of HIIT on affective responses relative to MICT. Exercise feelings related to physical exhaustion was significantly higher in HIIT relative to MICT when controlling for pre-class scores. Additionally, in-class affect was significantly lower in HIIT relative to MICT when controlling for pre-class scores. Enjoyment, post-class affect, self-efficacy, arousal, and exercise feeling related to

positive engagement, tranquility, and revitalization did not differ significantly between conditions when controlling for pre-class scores. Since participants in this study were homogenous and highly active, future research is warranted with young adults who are more representative of the population.

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Appendix A

IRB Approval Form

UNIVERSITY OF MINNESOTA

Twin Cities Campus

Human Research Protection Program
Office of the Vice President for Research

Room 350-2
McNamara Alumni Center
200 Oak Street S.E.
Minneapolis, MN 55455

612-626-5654
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APPROVAL OF NEW STUDY

November 5, 2020

Beth Lewis

651-423-4733
blewis@umn.edu

Dear Beth Lewis:

On 10/2/2020, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Affective responses of HIIT relative to CT delivered via video
Investigator:	Beth Lewis
IRB ID:	STUDY00010935
Sponsored Funding:	None
Grant ID/Con Number:	None
Internal UMN Funding:	None
Fund Management Outside University:	None
IND, IDE, or HDE:	None
Documents Reviewed with this Submission:	• Remembered and Forecasted Pleasure (HIIT).pdf, Category: Other; • Borgs (2010).pdf, Category: Other; • Leisure Time Exercise Questionnaire.pdf, Category: Other; • Pre-Screening Questionnaire.pdf, Category: Other; • Final Exercise Log Form (1).pdf, Category: Other; • 16-EFI-Survey.pdf, Category: Other; • Remembered and Forecasted Pleasure (CT).pdf, Category: Other; • Recruitment Email.pdf, Category: Recruitment

	Materials; • Future Intention to Exercise.pdf, Category: Other; • Social Template Protocol- Tyler Dregney, Category: IRB Protocol; • The Exercise Self-Efficacy Scale (ESES).pdf, Category: Other; • Consent Form.pdf, Category: Consent Form; • Reasons for Exercise Inventory.pdf, Category: Other; • Felt Arousal Scale.pdf, Category: Other; • Enjoyment - PACES.pdf, Category: Other; • Pre-Class Surveys.pdf, Category: Other;

The IRB determined that the criteria for approval have been met and that this study involves no greater than minimal risk.

The IRB also made the following determinations for this study: This research has been approved to enroll pregnant women. The research holds no prospect of benefit for the woman nor the fetus, the risk to the fetus is not greater than minimal, and the purpose of the research is the development of important biomedical knowledge that cannot be obtained by any other means. Consent from the mother is required.

This study does not require continuing review. The revised Common Rule (2018 Rule) eliminated continuing review for most minimal risk research approved on or after January 21, 2019. However, the elimination of continuing review does not eliminate reporting requirements or submission of modifications for IRB review and approval. Information about 2018 Rule requirements and investigator responsibilities can be found in the Investigator Manual (HRP-103).

You must also submit a Modification in ETHOS for review and approval prior to making any changes to this study.

If consent forms or recruitment materials were approved, those are located under the Final column in the Documents tab in the ETHOS study workspace.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the HRPP Toolkit Library on the IRB website.

For grant certification purposes, you will need the approval and last day of approval dates listed above and the Assurance of Compliance number which is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA00004003).

IMPORTANT: All human research conducted at the University of Minnesota must adhere to the IRB guidance and requirements, Office of the Vice President for

Research guidance, and the Medical School/Office of Academic Clinical Affairs Sunrise Implementation Plan in response to the COVID-19 pandemic. Non-medical school investigators should contact their Associate Dean for Research for information on the "sunrise" process.

Even with IRB approval, in-person research visits may not take place without documented approval by either the Medical School/OACA sunrise process or the Associate Dean for Research sunrise process. These reviews are intended to protect the health of all research participants and the broader University/Fairview communities during the COVID-19 pandemic. Researchers must inform the IRB of their approved sunrise plans. The IRB will document the approval status on ETHOS via a comment in the study history section. Please note that IRB approved COVID-19 related research is exempt from the sunrise requirements.

All researchers should review the guidance for the IRB, the medical school and their own departments as guidance is updated frequently.

We strive to provide clear, consistent and timely service to maintain a culture of respect, beneficence and justice in research. Complete a brief survey about your experience.

Sincerely,

Bri Warner
IRB Analyst

Appendix B

Recruitment Email

Affective responses of HIIT relative to CT delivered via video

Dear _____,

Volunteers are needed for a study at the University of Minnesota that is investigating how one's experience in a 25-minute, high intensity interval training (HIIT) class impacts their affective responses relative to a 25-minute continuous training physical activity session when delivered via video. The study will be conducted online so participants will need to be logged in to the Zoom call for approximately 45 minutes to an hour to complete questionnaires and their randomly assigned session of physical activity. The class will be taught by a certified instructor. **Upon completion, ALL participants will be given extra credit in one of their KIN courses.**

To be eligible for participation you must:

- Be a college student
- Be in good physical health
- Be able to safely perform high intensity interval training exercise for 25 minutes

If you are interested in participating and/or have any questions, please contact the student researcher, Tyler Dregney, via email dregn011@umn.edu. The researcher is a Masters student within the School of Kinesiology.

Appendix C

Pre-Screening Questionnaire

Q1 How did you hear about the study?

- ○ In class (1)
- ○ Email (2)
- ○ Other (3)

Q2 1. Which of the following do you consider to be your racial group?

- ○ American Indian/Alaskan Nature (1)
- ○ Asian (2)
- ○ Black or African-American (3)
- ○ Native Hawaiian or other Pacific Islander (4)
- ○ White (5)
- ○ Other (6)
- ○ Prefer not to say (7)

Q3 1. Which of the following do you consider to be your ethnic group?

- ○ Hispanic or Latino (1)
- ○ Not Hispanic or Latino (2)

Q4 Do you currently have a membership to the University of Minnesota Recreation and Wellness Center?

- ○ Yes (1)
- ○ No (2)

Q5 Are you a student?

○ Yes (1)

○ No (2)

Q6 Are you currently pregnant?

*If you are pregnant or think you may be pregnant, please consult with your health care provider about whether you may safely exercise at high intensity such as that required by participation in this study

○ Yes (1)

○ No (2)

Q7 Have you been instructed by a healthcare provider to not exercise or to limit their physical activity?

○ Yes (1)

○ No (2)

Q8 Do you experience any of the following? (please check all that apply)

○ Chest discomfort with exertion (1)

○ Unreasonable breathlessness (2)

○ Dizziness, fainting, blackouts (3)

○ Ankle swelling (4)

○ Unpleasant awareness of a forceful, rapid, or irregular heart rate (5)

○ Burning or cramping sensations in your lower legs when walking short distances (6)

Q9 Have you performed planned, structured physical activity for at least 30 minutes at moderate intensity on at least three days per week for at least the past three months?

○ Yes (1)

○ No (2)

Q10 Have you had, or do you currently have any of the following? (please check all that apply)

○ Heart attack (1)

○ Heart surgery, cardiac catheterization, or coronary angioplasty (2)

○ Pacemaker/implantable cardiac defibrillator/rhythm disturbance (3)

○ Heart valve disease (4)

○ Heart failure (5)

○ Heart transplantation (6)

○ Congenital heart disease (7)

○ Diabetes (8)

○ Renal disease (9)

Q11 Please list ANY other conditions that may prevent you from exercising or doing physical activity safely.

_____

Q12 Are you able to read, write, speak, and understand English?

○ Yes (1)

○ No (2)

Q13 Have you participated in a HIIT class before?

○ Yes (1)

○ No (2)

Q14 Please type in your full name

_____

Q15 Please type in your school email address (@umn.edu)

_____

Q16 You will receive an email from the student investigator (Tyler Dregney) regarding your eligibility to participate in this study after completing this pre-screening questionnaire.

*This is the initial questionnaire, meaning completing this questionnaire does not mean you have completed the participation required to receive credit for this study

Appendix D

Consent Form

Title of Research Study: ***Affective Responses of High Intensity Interval Training (HIIT) Relative to Continuous Training (CT) Delivered Via Video***

Investigator Team Contact Information: ***Tyler Dregney***
For questions about research appointments, the research study, research results, or other concerns, call the study team at:

Investigator Name: Beth Lewis Investigator Department Affiliation: School of Kinesiology Phone Number: 612-625-0756 Email Address: blewis@umn.edu	Student Investigator Name: Tyler Dregney Phone Number: 608-495-2653 Email Address: dregn011@umn.edu

Supported By: Research is supported by the University of Minnesota

Key Information About This Research Study:
This study aims to examine the affective responses of individuals who complete either a 25-minute session of High Intensity Interval Training (HIIT) or Continuous Training (CT) presented via video.

What is research?
The goal of research is to learn new things in order to help people in the future. Investigators learn things by following the same plan with a number of participants, so they do not usually make changes to the plan for individual research participants. You, as an individual, may or may not be helped by volunteering for a research study.

Why am I being invited to part in this research study?
As a student who is enrolled in one of the select Kinesiology courses (KIN 1701, KIN 1871, or KIN 3982), you are a potential participant. We are asking you to take part in this research study because you responded to an advertisement, email or presentation and met the eligibility requirements for the study based on the pre-screening questionnaire. We ask that you read this form and ask any questions you have before you decide whether you want to be in the study.

What should I know about a research study?
- Someone will explain this research study to you.
- Whether or not you take part is up to you.
- You can choose not to take part.
- You can agree to take part and later change your mind.
- Your decision will not be held against you.
- You can ask all the questions you want before you decide

Why is this research being done?
The purpose of this study is to examine the affective responses of individuals to a 25-minute High Intensity Interval Training (HIIT) session relative to a Continuous Training session delivered via video. We are interested in how participation in a single session of HIIT might influence a participant's affective responses.

How long will the research last?
We expect that you will be in this research study for approximately one hour (20 minutes to complete pre-class questionnaires, 25-minute class, and 15 minutes to complete post-class questionnaires).

What will I need to do to participate?
You will be asked to complete a pre-class questionnaire packet, participate in a 25-minute session of physical activity, and complete a post-class questionnaire packet.

More detailed information about the study procedures can be found under "What happens if I say yes, I want to be in this research?"

What are the risks of being in this study? Is there any way being in this study could be bad for me?
There are three risks associated with this study. First, it is possible that you could experience a cardiac arrest or some other medical event as a result of exercise. This risk is considered minimal. You reviewed the screening criteria for a list of possible health that would prevent you from safely exercising, so it is not anticipated you will have an adverse health reaction to the class. However, if you do experience an adverse health reaction, please notify your healthcare provider immediately. The second risk is that you could sustain an injury while exercising. This risk is considered minimal. The instructor will show exercises that are easily modifiable allowing the participants to ensure the exercises performed are safest for you. The third risk is because the questionnaires ask personal questions, you may feel uncomfortable answering some of the questions. All responses will be confidential and not linked to your name or contact information.
*If you are pregnant or think you may be pregnant, please consult with your health care provider about whether you may safely exercise at high intensity such as that required by participation in this study?

Will being in this study help me in any way?
There are no benefits to you from participating in this research. We cannot promise any benefits to others from you participating in this research. However, possible benefits to others include helping researchers and practitioners understand ways to provide group exercise students with positive class experiences.

What happens if I do not want to be in this research?
There are no known alternatives, other than deciding not to participate in this research study. Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with The University of Minnesota.

Detailed Information About This Research Study
The following is more detailed information about this study in addition to the information listed above.

How many people will be studied?
We expect about 40 people will participate in this research study.

What happens if I say "Yes, I want to be in this research"?
If you agree to be in this study, we would ask you to do the following things: Upon logging in to the Zoom call where the study will be conducted, you will be welcomed by the research staff and given an overview of what will take place. The overview includes informed consent, pre-class questionnaire packet, randomization into HIIT or CT, the 25-minute physical activity class, and post-class questionnaire packet. The questionnaires and forms will be provided to participants through Qualtrics once they are logged in.

First you will complete this consent form. Once you do this, you will be given the pre-class questionnaire packet. You will complete the pre-class questionnaire packet. After you complete it, and all the other participants have also completed the packet, all participants will be randomized to either HIIT or CT. Following this, the 25-minute physical activity classes will begin. We ask that you participate to your best ability in the class. The video will offer exercises that are easily modifiable and ask you to choose the safest version of each exercise for you and that you work at your own pace. After the class is complete, you will receive the post-class questionnaire. Once you complete this packet and turn it in, you will be given your incentive and be free to go.

The class you are assigned to will be chosen by chance, like flipping a coin. Neither you nor the investigator will choose which class you are assigned. You will have an equal chance of being given either type of class. You will be informed which class you have been assigned immediately before beginning.

What happens if I say "Yes", but I change my mind later?
You can leave the research study at any time and no one will be upset by your decision. Choosing not to be in this study or to stop being in this study will not affect your current or future relations with the University of Minnesota. You decide not to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Will it cost me anything to participate in this research study?
There will be no cost to you for any of the study activities or procedures.

What happens to the information collected for the research?
Efforts will be made to limit the use and disclosure of your personal information to people who have a need to review this information. We cannot promise complete confidentiality. Organizations that may inspect and copy your information include the Institutional Review Board (IRB), the committee that provides ethical and regulatory

oversight of research, and other representatives of this institution, including those that have responsibilities for monitoring or ensuring compliance. We will not ask you about child (or vulnerable adult) abuse, but if you tell us about child (or vulnerable adult) abuse or neglect, we may be required or permitted by law or policy to report authorities.

Whom do I contact if I have questions, concerns, or feedback about my experience?
This research has been reviewed and approved by an IRB within the Human Research Protections program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Will I have a chance to provide feedback after the study is over?
The HRPP may ask you to complete a survey that asks about your experience as a research participant. You do not have to complete the survey if you do not want to. If you do choose to complete the survey, your responses will be anonymous.

If you are not asked to complete a survey, but would like to share feedback, please contact the study team or the HRPP. See the "Investigator Contact Information" of this form for study team contact information and "Whom do I contact if I have questions, concerns, or feedback about my experience?" of this form for HRPP contact information.

What happens if I am injured while participating in this research?
In the event that this research activity results in an injury, be sure to call your healthcare provider immediately. Care for such injuries will be billed in the ordinary manner, to you or your insurance company. If you think that you have suffered a research related injury let your physician know right away.

Will I be compensated for my participation?
If you agree to take part in this research study, we will provide you with extra credit for one of your Kinesiology courses at the University of Minnesota. You will receive the extra credit immediately upon completing the post-class questionnaires.

Use of Identifiable Health Information
The results of this study may also be used for teaching, publications, or for presentation at scientific meetings. I any sort of report we might publish, we will not include any information that will make it possible to identify you.

Your signature documents your permission to take part in this research. You will be provided a copy of this signed document.

_____

Signature of Participant Date

_____

Printed Name of Participant

_____

Signature of Person Obtaining Consent Date

_____

Printed Name of Person Obtaining Consent

Appendix E

Pre-Class Survey

1. What is your assigned ID number?

2. What is your target heart rate zone?

Exercise-Induced Feeling Scale

(Gauvin & Rejeski, 1993)

HOW ARE YOU FEELING?

Instructions: Please use the following scale to indicate the extent to which each word describes how you feel at this moment in time. Record your responses by circling the appropriate number next to each word.

Feeling	Do not feel	Feel slightly	Feel moderately	Feel strongly	Feel very strongly
1. Refreshed	0	1	2	3	4
2. Calm	0	1	2	3	4
3. Fatigued	0	1	2	3	4
4. Enthusiastic	0	1	2	3	4
5. Relaxed	0	1	2	3	4
6. Energetic	0	1	2	3	4
7. Happy	0	1	2	3	4
8. Tired	0	1	2	3	4
9. Revived	0	1	2	3	4
10. Peaceful	0	1	2	3	4
11. Worn out	0	1	2	3	4
12. Upbeat	0	1	2	3	4

Physical Activity Enjoyment Scale

(Kendzierski & DeCarlo, 1991)

Please rate how you feel at the moment about physical activity. Below is a list of feelings with respect to physical activity. For each feeling, please mark the number that best describes you.

I enjoy it	1	2	3	4	5	6	7	I hate it
I feel bored	1	2	3	4	5	6	7	I feel interested
I dislike it	1	2	3	4	5	6	7	I like it
I find it pleasurable	1	2	3	4	5	6	7	I find it unpleasurable
I am very absorbed in physical activity	1	2	3	4	5	6	7	I am not at all absorbed in physical activity
It's no fun at all	1	2	3	4	5	6	7	It's a lot of fun
I find it energizing	1	2	3	4	5	6	7	I find it tiring
It makes me depressed	1	2	3	4	5	6	7	It makes me happy
It's very pleasant	1	2	3	4	5	6	7	It's very unpleasant
I feel good physically while doing it	1	2	3	4	5	6	7	I feel bad physically while doing it
It's very invigorating	1	2	3	4	5	6	7	It's not at all invigorating
I am very frustrated by it	1	2	3	4	5	6	7	I am not at all frustrated by it
It's very gratifying	1	2	3	4	5	6	7	It's not at all gratifying
It's very exhilarating	1	2	3	4	5	6	7	It's not at all exhilarating
It's not at all stimulating	1	2	3	4	5	6	7	It's very stimulating
It gives me a strong sense of accomplishment	1	2	3	4	5	6	7	It does not give me any sense of accomplishment
It's very refreshing	1	2	3	4	5	6	7	It's not at all refreshing
I felt as though I would rather be doing something else	1	2	3	4	5	6	7	I felt as though there was nothing else I would rather be doing

Feeling Scale

(Hardy & Rejeski, 1989)

Please rate how you currently feel.

Immediately before workout

How do you currently feel?

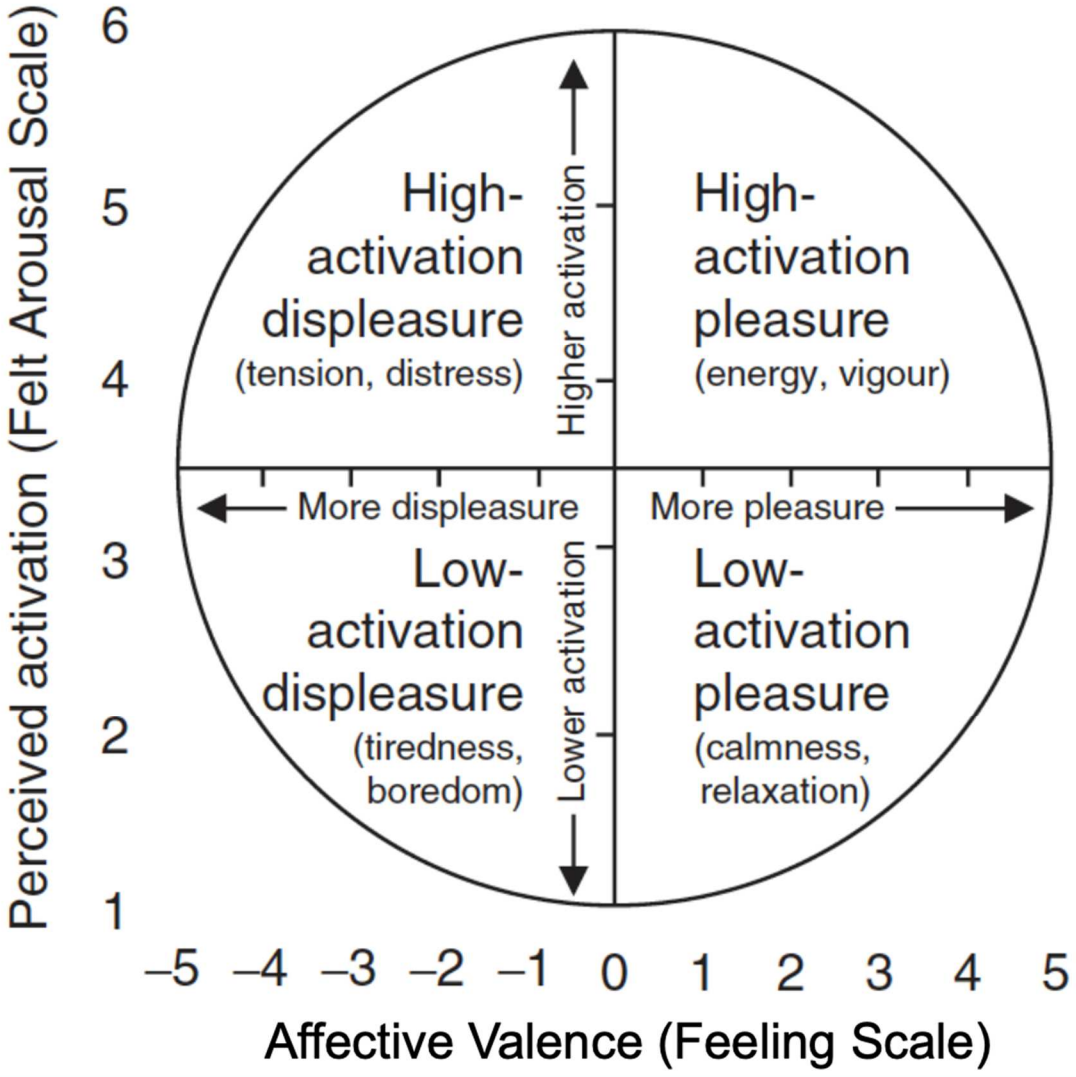
	-5	Very bad
	-4	
	-3	Bad
	-2	
	-1	Fairly bad
	0	Neutral
	+1	Fairly good
	+2	
	+3	Good
	+4	
	+5	Very good

Use the following scale to indicate how much you are enjoying this exercise session.

	1	Not at all
	2	Very little
	3	Slightly
	4	Moderately
	5	Quite a bit
	6	Very much
	7	Extremely

Felt Arousal Scale

Ekkekakis et al., 2011; Russell & Barrett, 1999



Future Intention to Exercise Scale

"Please rate the likelihood that you will return to a similar physical activity class in the future from 0% to 100%"

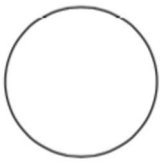
_____

Leisure Time Exercise Questionnaire

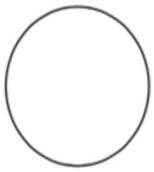
(Godin & Shephard, 1985)

1) Considering a **7-day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write in each circle the appropriate number).

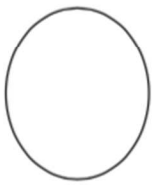
A) STRENUOUS EXERCISE
(HEART BEATS RAPIDLY)
(i.e., running, jogging, hockey, football soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)



B) MODERATE EXERCISE
(NOT EXHAUSTING)
(i.e., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)



C) MILD EXERCISE
(MINIMAL EFFORT)
(i.e., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking



2) Considering a **7-day period** (a week), during your leisure-time, how often do you engage in any regular activity long enough to **work up a sweat** (heart beats rapidly)?

Often Sometimes Never/rarely

Reasons for Exercise Inventory

(Silberstein et al., 1988)

People exercise for a variety of reasons. When people are asked why they exercise, their answers are sometimes based on the reasons they believe they should have for exercising. What we want to know are the reasons people actually have for exercising. Please respond to the items below as honestly as possible. **To what extent is each of the following an important reason that you have for exercising?** Indicate your response to each item by circling the appropriate number, ranging from 1 (not at all important) to 7 (extremely important).

	Not at all important			Moderately important			Extremely important
1. To be slim	1	2	3	4	5	6	7
2. To improve my muscle tone	1	2	3	4	5	6	7
3. To maintain physical well-being	1	2	3	4	5	6	7
4. To cope with sadness, depression	1	2	3	4	5	6	7
5. To improve my appearance	1	2	3	4	5	6	7
6. To improve my strength	1	2	3	4	5	6	7
7. To cope with stress, anxiety	1	2	3	4	5	6	7
8. To redistribute my weight	1	2	3	4	5	6	7
9. To improve my endurance, stamina	1	2	3	4	5	6	7
10. To increase my energy level	1	2	3	4	5	6	7
11. To be attractive to others	1	2	3	4	5	6	7
12. To improve my flexibility, coordination	1	2	3	4	5	6	7
13. To improve my mood	1	2	3	4	5	6	7
14. To lose weight	1	2	3	4	5	6	7
15. To improve my cardiovascular fitness	1	2	3	4	5	6	7
16. To meet new people	1	2	3	4	5	6	7
17. To improve my overall body shape	1	2	3	4	5	6	7
18. To increase my resistance to illness and disease	1	2	3	4	5	6	7
19. To socialize with friends	1	2	3	4	5	6	7
20. To be sexually desirable	1	2	3	4	5	6	7
21. To improve my overall health	1	2	3	4	5	6	7
22. To have fun	1	2	3	4	5	6	7
23. To alter a specific area of my body	1	2	3	4	5	6	7
24. To maintain my current weight	1	2	3	4	5	6	7

Exercise Self-Efficacy Scale (ESES)

Adapted from Kroll et al. The SCI Exercise Self-Efficacy Scale (ESES): Development and psychometric properties, International Journal of Behavioral Nutrition and Physical Activity, Vol 4, 2007; Table 1 .

This scale instructs participants to answer on a 4-point rating scale how confident they are with regard to carrying out regular physical activities and exercise.

ESES Rating Scale:
1 = not always true
2 = rarely true
3 = moderately true
4 = always true

Patient Name: _____ Date: _____

I am confident….	**Rating:**
1) that I can overcome barriers and challenges with regard to physical activity and exercise if I try hard enough	1 2 3 4
2) that I can find means and ways to be physically active and exercise	1 2 3 4
3) that I can accomplish my physical activity and exercise goals that I set	1 2 3 4
4) that when I am confronted with a barrier to physical activity or exercise I can find several solutions to overcome this barrier	1 2 3 4
5) that I can be physically active or exercise even when I am tired	1 2 3 4
6) that I can be physically active or exercise even when I am feeling depressed	1 2 3 4
7) that I can be physically active or exercise even without the support of my family or friends	1 2 3 4
8) that I can be physically active or exercise without the help of a therapist or trainer	1 2 3 4
9) that I can motivate myself to start being physically active or exercising again after I've stopped for a while	1 2 3 4
10) that I can be physically active or exercise even if I had no access to a gym, exercise, training, or rehabilitation facility	1 2 3 4

Sum: _____

Rate of Perceived Exertion Scale

(Borg, 1982)

Rating	Descriptor
6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion